Space Weather Technical Forecast

Issued on Friday 10 January 2025 at 01:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares. A chance of Active electron fluence on Day 1 (10 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low solar activity during the last 24 hours with only C-class flares, the peak a C5.0 flare at 09/2140 UTC from AR3947. There was one long duration C4.1 flare associated with a filament lift of to the northeast of AR3947 at 09/1119 UTC, from this a weak delta spot appears to have redeveloped in AR3947s intermediate spots. AR3947 remains the largest and most magnetically complex region on the Earth-facing disc. The eleven other regions on the visible disc remain small and simple at present.

Due to a lack of recent SOHO coronagraph imagery combined with large gaps in STEREO coronagraph imagery the detection of CMEs is more uncertain than usual. A possible filament eruption near the centre disc may bring some enhancement at Earth, however this can not be correlated with coronagraph imagery at present.

Solar Wind / Geomagnetic Activity: Solar winds were initially slight elevated around 410km/s but declined to background levels, around 350km/s then possibly followed by a weak HSS onset, increasing to 390km/s. Density was average or below. The Interplanetary Magnetic Field, Bt, was initially weak rising to moderate from 09/1130 UTC with a peak of 10nT. The north-south component, Bz, was variable, generally weak but with a moderate negative interval around 09/1432 UTC at -10nT. Phi angle was mainly positive (away from the Sun), with a brief negative (towards the Sun) interval between 09/0900-1230 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES-18 was at background levels. High energy electron flux (greater than 2MeV) at GOES16 has been diurnally high, peaking at 1520 pfu at 09/1055 UTC. The associated 24 hour fluence remained below the the Active threshold on a slight declining trend, reading 4.11e7 integrated pfu at 10/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate with an ongoing chance of isolated M-class flares.

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Solar Wind / Geomagnetic Activity: A lack of SOHO coronagraph imagery and STEREO imagery means that CME analysis is difficult and comes with increased uncertainty. A possible filament eruption from near AR3947 may bring some enhanced geomagnetic activity, most likely on Day 3 (12 Jan). Solar winds are showing signs of some weak disturbance, perhaps an early onset of the high speed stream from CH07/+. Wind speeds from this feature are likely to be not much above 400 km/s.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, perhaps with the odd Active interval Day 1 (10 Jan) with any high speed stream influence. Any CME influence is likely to be rather dense, with a chance of G1 to G2 Minor/Moderate storms and a slight chance of G3/Strong storms intervals on Day 3 (12 Jan).

Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to remain near background levels, with only a slight chance of rising in response to any notable flares. GOES 16 high energy electron flux is forecast to continue at mainly Moderate perhaps peaking at High levels. There is a chance associated 24 hour fluence may rise above the Active threshold on Day 1 (10 Jan), perhaps with a slow declining trend thereafter.

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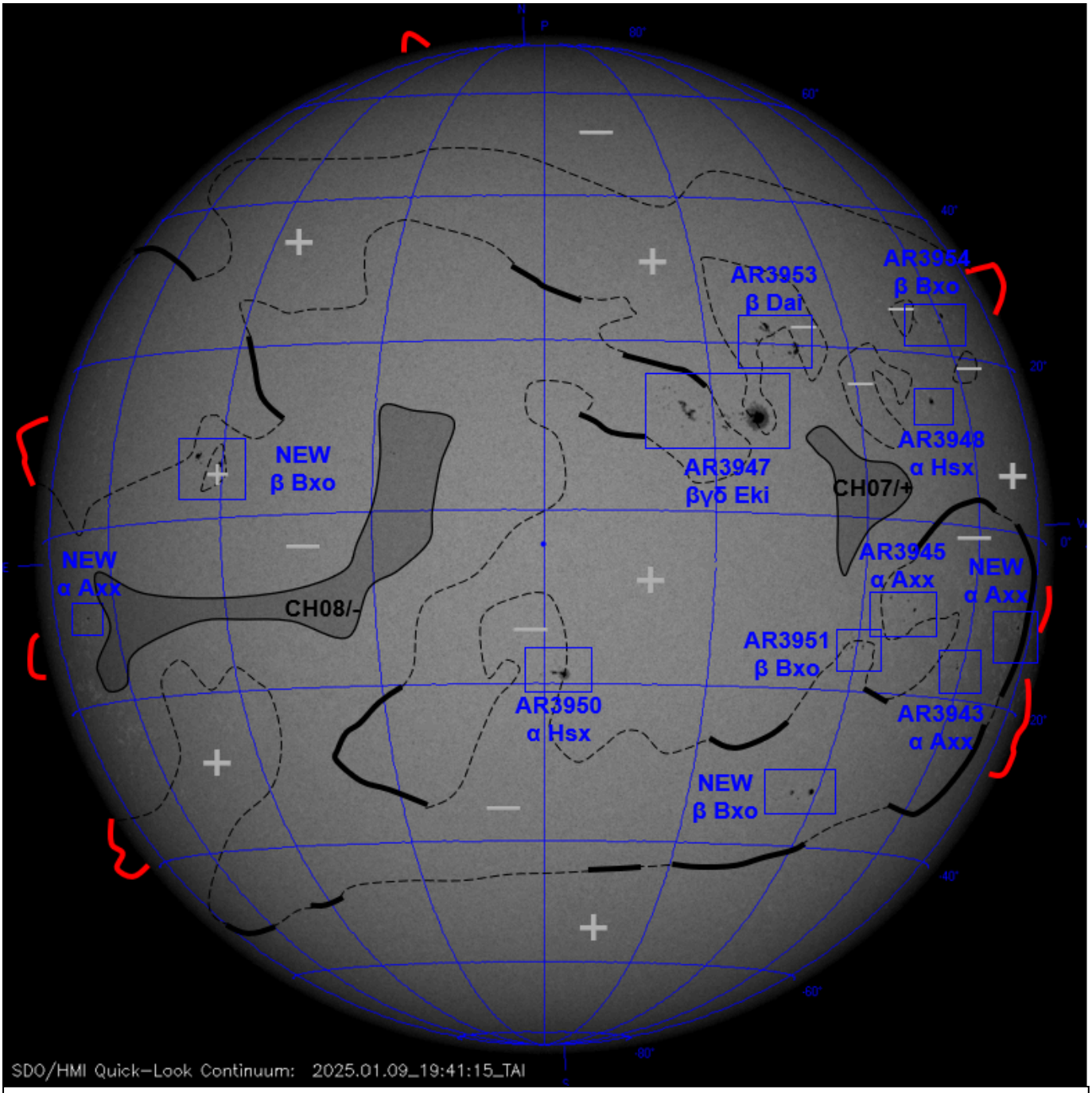
Figure 1: Solar Synoptic Map valid 09/1941 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Solar winds recently declined to background levels after the high speed stream from CH05/+. However, there's been perhaps some indications that we have connected to a high speed stream from CH07/+ from around 09/0930 UTC. Whilst this is a little earlier than expected, this feature is small, and reduced from the previous rotation where it gave 400-450 km/s. Therefore, wind speeds this time around are likely to be not much above 400 km/s and with no more than Active geomagnetic intervals expected.

A filament eruption to the northeast of AR3947 appears on SDO/AIA 304 imagery and GONG H-alpha around 09/1030 UTC and saw a long duration C-class flare. Given the lack of SOHO coronagraph imagery combined with large gaps in STEREO imagery its difficult to attain if any material was directed towards Earth as a result of this eruption. Given its location near centre disc, it is possible that we could see an Earth-directed component, but this is treated with significant uncertainly. Estimating a CME speed of between 500-1000km/s would bring impacts at Earth somewhere between late (UTC) on Day 2 (11 Jan) to the early hours Day 4 (13 Jan).

Geomagnetic activity is expected to be mostly Quiet to Unsettled, perhaps with the odd Active interval Day 1 (10 Jan) with any high speed stream influence. Any CME influence is likely to be rather dense, with a chance of G1 to G2 Minor/Moderate storms and a slight chance of G3/Strong storms intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	20	25	15
Strong	G3	No	1	5	10	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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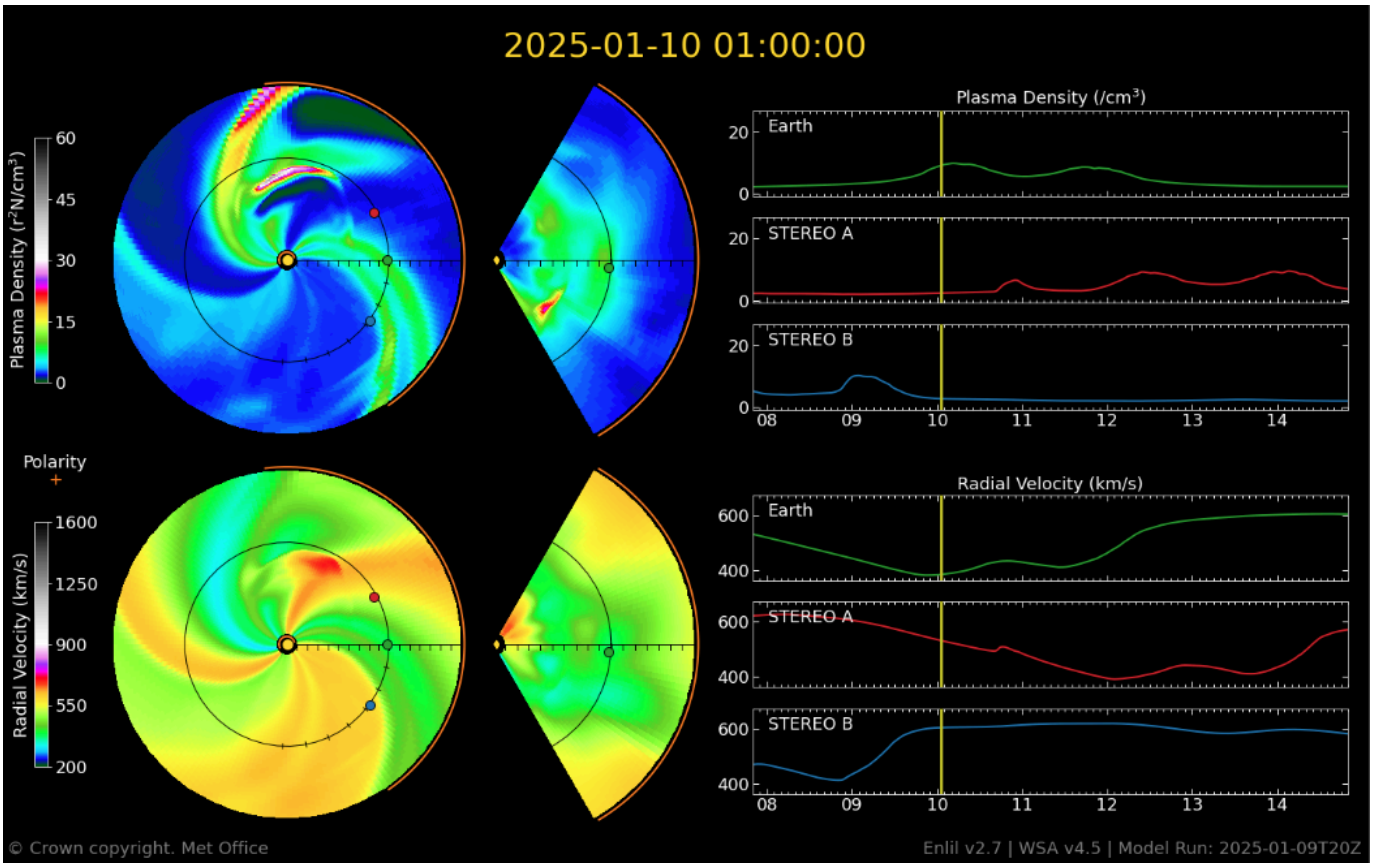
Figure 2: MOSWOC Enlil showing a gradual decrease of solar wind speeds before rising towards the end of the period, this is believed to be CH08/- and represented in Enlil output a little too early.



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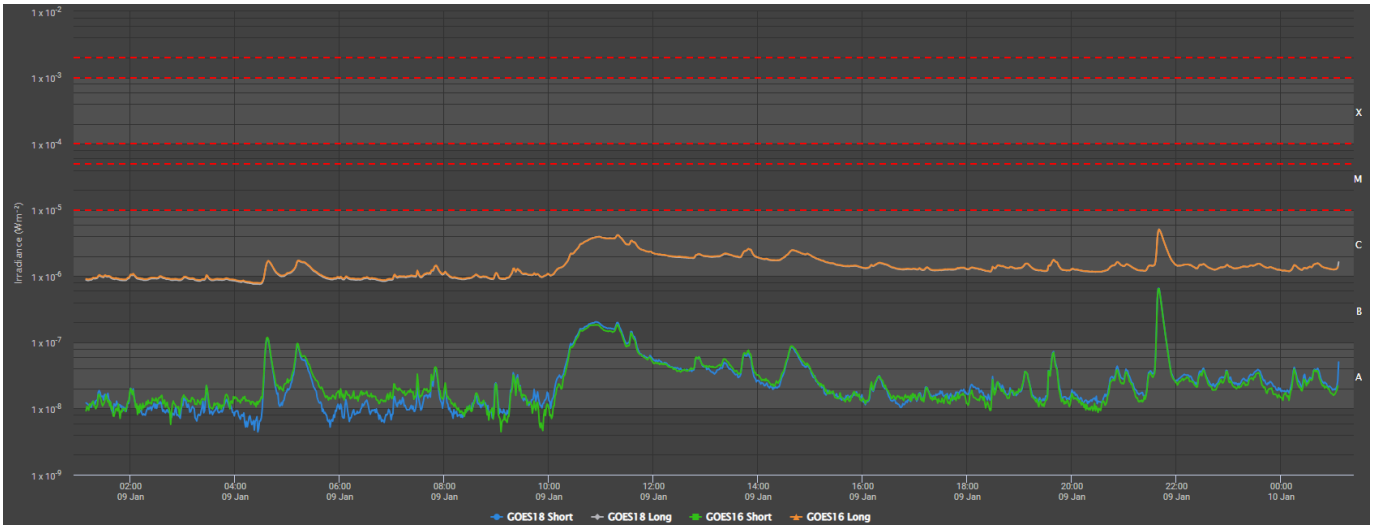
Radio Blackouts - X-Ray Flares

Low solar activity during the last 24 hours with only C-class flares, one long duration C4.1 flare associated with a filament lift of to the northeast of AR3947 at 09/1119 UTC. A further C5.0 occurred at 09/2140 UTC from AR3947. There remains a chance of isolated M-class flares, primarily from AR3947.

There are now twelve sunspot regions on the visible disc. AR3947 remains the largest and most magnetically complex and has been responsible for the majority of recent flare activity. Following a filament eruption close to AR3947 at 09/1100 UTC a weak delta spot appears to has redeveloped in its intermediate spots. Three new unnumbered regions have developed although at this time remain small and simple. The other regions on the disc remain small and simple at present.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES16&18 X-ray flux trace.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has remained at background over the last 24 hours. There is a slight chance of an enhancement as AR3947, the most complex spot exists in the western hemisphere throughout the forecast period. This region has been the source of many M-class flares and isolated X-class flares. Furthermore, there are a number of filaments currently on the disc, and it is not impossible that a large eruption from any of these could result in Earth-directed high energy protons.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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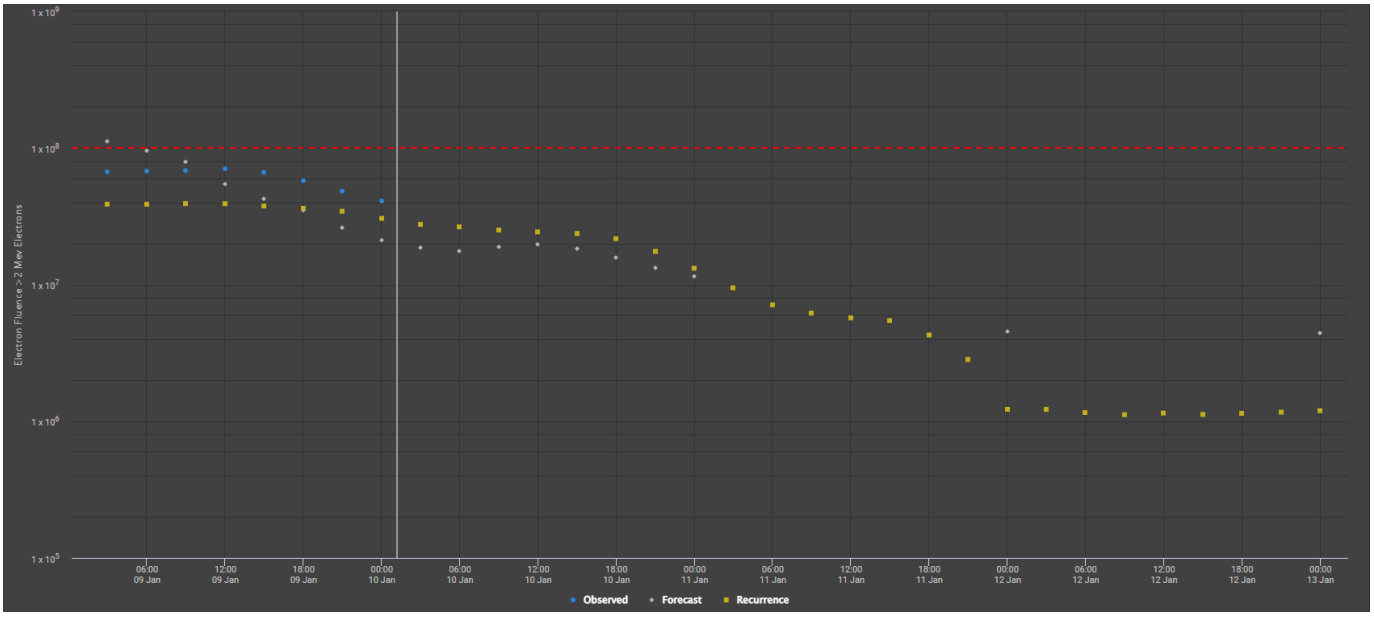
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been varying between Moderate and diurnally High values over the last few days. This is as a result of the recent fast wind enhancement from CH05. Now solar wind speeds have eased, there is the possibility of a further increase as the radiation belts fully expand back to incorporate GEO. However, there is some uncertainty as to the strength of any high speed stream from CH07, which may be starting to show an influence at L1. Whilst this could compress the radiation belts once again, it is considered likely to be weak and may have little influence. Overall, it is probable that electron flux values will remain Moderate, diurnally High, possibly with an decrease in the diurnal maximum on Day 1 (10 Jan).

Fluence is currently near the Active threshold, albeit with a slight declining trend. There is a chance that this may rise above the Active threshold on Day 1 (10 Jan), perhaps with a slow declining trend thereafter. REFM is suggesting a fairly sharp decline in values, and is likely to be declining too fast and too soon.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	50	40	40	60
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM showing a declining trend.



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